Circuits	**Internal resistance**

Learning objectives	**MUST (6)**	Understand internal resistance of power supplies and why there are 'lost volts' in the circuit
	SHOULD (7)	Perform circuit calculations including internal resistance
	COULD (8/9)	Explain applications of, and graphs relating to, internal resistance

STARTER: Peer-marking of homework

Extension: I have a cell/battery (of unknown emf) and a resistor in series, hidden in a box. Can I tell what the resistor is? How?

Circuits	**Internal resistance**
MUST (6)	Understand internal resistance of power supplies and why there are 'lost volts' in the circuit

In every power source, work - emf - is done **on** charge carriers. However, a smaller amount of work is done **by** charge carriers in the cell:

Chemical cell - due to chemical reactions

Solar cell - due to resistance of cell materials

Energy is transferred into heat, and therefore the full emf is not actually available in the circuit. If we measure the p.d. at the terminals (terminal p.d.) it will be less than the emf. The difference is the 'lost volts'.

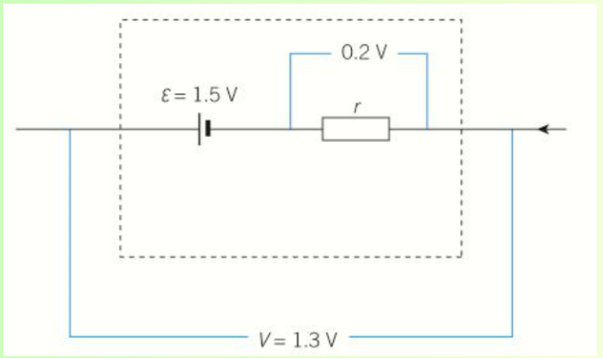
Current affects the 'lost volts' because:

We draw internal resistance:

r (lower case) next to cell

Dashed line denoting all part of power source

Kirchoff's second law applies



Circuits	**Internal resistance**

SHOULD (7)	Perform circuit calculations using internal resistance

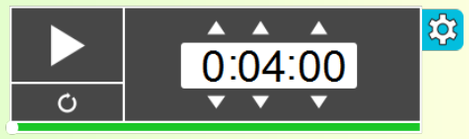
If ε is emf, V is terminal pd, r is internal resistance then:

ε = V + lost volts

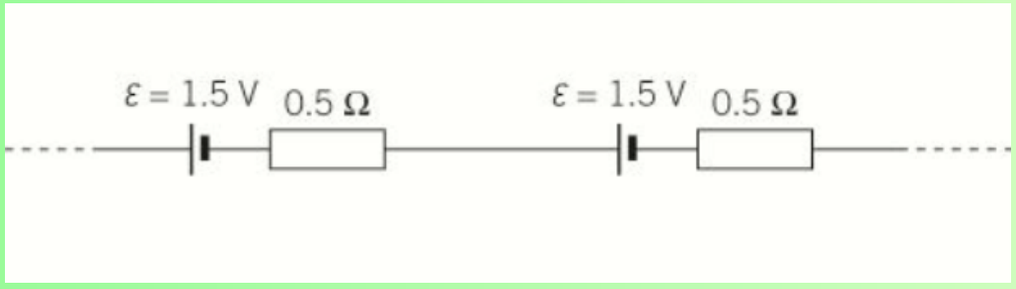
ε = V + Ir

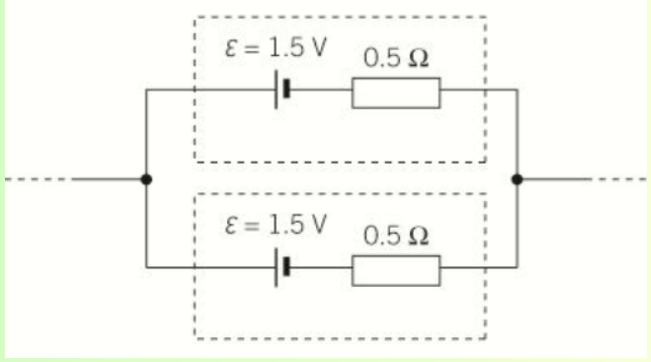
ε = IR + Ir or I(R + r)

How does r affect our calculations?



Consider cells with ε = 1.5V, r = 0.5Ω in series and parallel. Total ε and resistance?





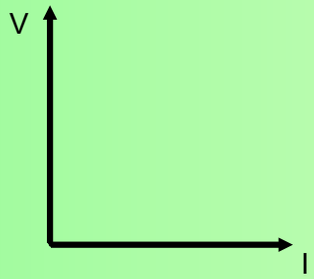
Circuits	**Internal resistance**
COULD (8/9)	Explain applications of, and graphs relating to, internal resistance

When would you need:

a high internal resistance? [redacted]

a low internal resistance? [redacted]

On a V-I graph showing terminal p.d, how would you show emf and r?



[redacted]

Answers

1 **a** 1.5 V

b 0.30 Ω

2 **a** 0.25 Ω

b 0.75 Ω

c 0.50 J

3 1.0 Ω

4 **a** 1.0 Ω

b 3.8 J

[redacted]